EVALUATION OF PERSIAN WILD GOAT CARRYING CAPACITY DETERMINATIONS, FLORIDA MOUNTAINS, NEW MEXICO

BY

V.W. Howard, Jr. Professor, Department of Fishery & Wildlife Sciences, NMSU
and
Patrick Morrow, Graduate Research Assistant, Department of Fishery & Wildlife Sciences, NMSU

A Report to the Bureau of Land Management
Las Cruces, N.M. District Office
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New Mexico Department of Game & Fish
Santa Fe, N.M.

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ABSTRACT

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Concern for key forage species and Persian wild goat population maintenance on the Florida Mountains, south of Deming, New Mexico, has shown a need for an evaluation of methods currently being used to sample browse plants. Data collection methods and results which affect the determination of carrying capacity for browsing ungulates were reveiwed.

Current systems in use by the Bureau of Land Management (BLM) were determined to be measuring only long term trends and were not observing individual plant condition factor differences on a year-by-year basis. It was recommended that permanent browse condition transects be established to measure individual plants on a yearly basis. Production of key forage species was needed so that carrying capacity determinations can be accessed.

Analysis of food habits data showed larger amounts of Cercocarpus breviflorus and Quercus sp. and lower amounts of Garrya wrightii in wild goats' diets compared to earlier food habits data. These 3 species comprised 91% of wild goats' diets, increasing from an average 76% from 1977 through 1979.

Browse condition comparisons suggested that wild goats and mule deer preferred areas having relative high combined composition of the 3 key browse species. These areas were preferred, especially, when precipitation was below the average. An average difference of 10% was observed over 7 years for combined compositions, indicating either actual composition variation, bias between observers, observer error, or a combination of factors. As frequency of use and severe hedging of 1 browse species increased, use and severe hedging of the 2 other species increased. Winter precipitation was directly related to frequency of use of mountain mahogany and oak, while summer/fall rainfall was negatively related to frequency of use of mountain mahogany.

Based on established locations of browse transects, condition factors for browse species were separated into 3 elevation zones. Wild goats occupied higher elevations more than lower elevations. Average fecal groups per acre for wild goats increased with increased elevation, while average fecal groups per acre for mule deer and cattle decreased with increased elevation. There were more mature and fewer decadent and dead browse plants observed at

$\leq$ 6200 feet. Highest average combined composition of the 3 browse species were at elevations between 6200 and 6800 feet. The highest percentages of frequency of use and severe hedging were found at $\geq$ 6800 feet.

Numbers of wild goats have increased at a rate of 24% annually over the last 8 years. During this time unexplained losses averaged 26% of the total population. The highest percentage legally taken in a year was 27% of the total population. The population seems to be increasing at a steady rate despite increased hunting pressure between 1979 and 1985.

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INTRODUCTION

The Persian wild goat (Capra aegagrus) was first introduced into the Florida Mountains in 1970. Seven total releases, involving 30 males and 43 females, were initiated between 1970 and 1977 (Morrison 1983). The Florida's were chosen on the basis that they contained a relatively unused habitat which could support an exotic ungulate population. Durham's (1969) preliminary investigations indicated the vegetation on the mountain range could support a wild goat population. He also concluded that mule deer (Odocoileus hemionus) numbers were low, and competition between the 2 ungulates would be minimal.

Since the initial release, several studies have been conducted on the Persian wild goat population on the Florida Mountains. Sutcliffe (1972) found goats to be settling into 3 main canyons, and their numbers were increasing 2 years after their release. He also stated that their high rate of reproduction would probably continue until the wild goat population had increased to fully occupy the available range. Woodroof (1979) analysed wild goat food habits and showed that mountain mahogany (Cercocarpus breviflorus), Wright's silk tassel (Garrya wrightii), and oak (Quercus sp.) were their primary foods. These 3 species also have been considered by the Bureau of Land Management (BLM) and New Mexico Department of Game and Fish (NMDG&F) as "key" browse species. Woodroof (1979) found these 3 species to comprise 75% of the wild goats' diets, 76.6% of the mule deer's diets, and

16.3% of cattle's diets.

In 1979 the Habitat Management Plan (HMP) for the Florida Mountains was completed by the BLM and NMDG&F. Planned actions of the HMP were to maintain or improve conditions of key forage species, protect vegetation and soil resources, and to improve water distribution. These were to be achieved by several means; (1) population censusing, (2) vegetation studies, (3) soil studies, (4) weather and climatic data examination, (5) carrying capacity determinations and (6) development and maintenance of water sources (HMP, BLM 1979).

Included in the HMP is the goal of determining a final carrying capacity for wild goats by 1987. Until 1987 an annual carrying capacity was to be set each year. Following an expressed concern from the NMDG&F as to the validity of the carrying capacity determinations, evaluations of these determinations were initiated. The primary concern was with the allowable use factors (AUFs) developed by the BLM for mountain mahogany, Wright's silk tassel and oak. These AUFs were set at 60%, 40% and 25%, respectively.

The main concern with the wild goat population on the Florida Mountains is over-utilization of key forage species. Woodroof (1979) found from reviewing aerial survey censuses that the wild goat population was increasing at a rate of 14 to 17% annually. His recommendation of a maximum population of 272 animals was

surpassed in 1980 and the population has continued to increase. In 1984 and 1985, the BLM set the allowable population at 400 animals (Annual Report, BLM 1984, 1985). Pre-hunt aerial surveys have shown more than 400 animals, yearly, since 1981. Hunting pressure has not been sufficient to restrict numbers.

Concern for key forage species and wild goat population maintainance on the Florida Mountains has indicated a need for evaluation of methods used and analyses of data collected. This report examines data collection methods and results which affect the determination of carrying capacity for browsing ungulates. Browse condition data are analysed statistically for possible trends. Fecal diet data are compared, showing constants and differences in food habits for mule deer and wild goats. Validity and accuracy of AUFs are reviewed. Trends which show population increases, from aerial survey censusing, also are discussed. This report will review findings and give recommendations as to the meaning of results, and management methods which should be initiated. The specific objectives of this report, as stated by the contract are as follows:

1. To evaluate the basic method being used to determine Persian wild goats' carrying capacity on the Florida Mountains.

2. To evaluate the methods of data collection for making Persian wild goat carrying capacity determinations on the Florida Mountains.

3. To evaluate the validity and accuracy of the allowable use factors, which are intended to be used with a weight percentage estimate of use, when these factors are used with the stem count method of determining browse utilization.

4. To compare Persian wild goat fecal diet data collected in the past with new fecal diet data, and to compare fecal diet data from the north end of the Florida Mountains with diet data from the south end of the Florida Mountains.

5. To make an evaluation of the annual Persian wild goat carrying capacity determinations which have been made by BLM through 1984, and provide recommendations in a final carrying capacity that will protect the vegetation community on the Florida Mountains.

STUDY AREA

The study area is located in the Florida Mountains, Luna County, New Mexico, 20 mi (32 km) southeast of Deming. Situated in the southwestern part of the state, the Florida's are a rugged north-south oriented desert range of approximately 8 mi (12.9km) x 5 mi (8.0 km) (Woodroof 1979). Florida Peak rises to an elevation of 7,448 ft (2,270 m). Three other peaks, South, Gym, and No-name also rise above 7,000 ft (2,134 m). The surrounding bolson plains, as described by Durham (1969), are approximately 4,200 ft (1,280 m) in elavation (Fig. 1).

The Florida Mountains are divided into a northern and southern portion along the main north-south ridge (Fig. 1). The hillsides of the north include slopes from 18 to 65 degrees, with a few approaching 90 degrees. The western slope ranges from 25 to 90 degrees. As with the northern portion, the southern slopes vary greatly. There are numerous rocky outcroppings thoughout the northern and southern sections. As a whole, the southern area has more gentle slopes near the ridge tops than does the northern area (Woodroof 1979).

In general, access into the interior of the range is mainly achieved on foot. There are, in different locations around the mountains, roads which lead directly to the base. Due to ruggedness, people seldom enter the interior except during hunting seasons.

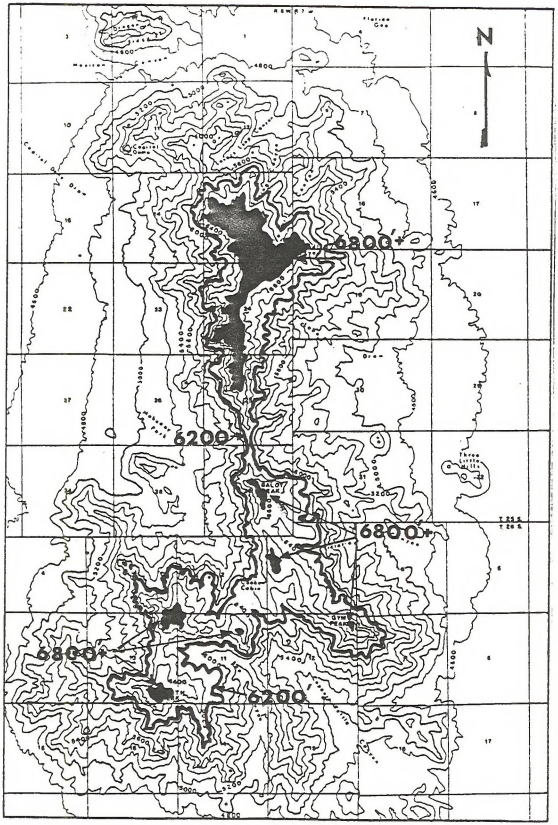


Figure 1. The Florida Mountains, Luna County, New Mexico depicting the area within 3 elevation zones.

The Florida Mountains are supplied with both natural and constructed water sources. Natural springs usually contain water during wet seasons, but can be dry when precipitation is low. Two water catchments have been installed, one in the north and one in the south. When checked in March, 1986, by BLM personnel, they were found to be functional and contained ample water in both tanks and drinkers. There are several man-made masonry dams and livestock watering troughs in different locations that are checked and maintained yearly.

Vegetation on the mountain range is varied. Annual forb abundance was highest on the east, south and west exposures (Durham 1969). Oak, which is 1 of the the 3 "key" browse species, was highest in abundance on the north and bottom exposures. The other 2 important browse species, mountain mahogany and Wright's silk tassel, were found in abundance in localized areas.

A combination of data reported by Bavin (1975) and Woodroof (1979) identified 19 mammal species, including mountain lion (Felis concolor), bobcat (Lynx rufus), and coyote (Canis latrans) as important predators. Another important predator observed on the range was the golden eagle (Aquila chrysaetos).

METHODS

Literature Search

A literature search was conducted in hope of collecting information that would pertain to carrying capacity as related to AUFs for the 3 "key" species mountain mahogany, Wright's silk tassel, and oak species. No literature was obtained, specifically, for Wright's silk tassel or oak species AUFs or other information which would pertain to the Persian wild goats on the Florida Mountains. However, some literature was obtained concerning allowable use from clipping studies on mountain mahogany. Pertinent literature will be discussed later. The literature search included reviewing the Biological Abstracts, Wildlife Reveiw, Journal of Range Management, Journal of Animal Science, Journal of Mammalogy, California Fish and Game Bulletin, New Mexico Department of Game and Fish Bulletin, Ecology, and an extensive search was conducted using the NMSU literature search computer. An additional search was made by Dr. G. Donart and Dr. R. Pieper of the Department of Range Science at NMSU.

Vegetation

Vegetational data were collected from the Florida Mountains by personnel from the Las Cruces, BLM office and NMDG&F. Browse conditions were estimated using browse transect sampling techniques. Browse transects were first established and read in April, 1980. The last sampling period was March, 1986. Transects were read in March and/or April of every year. The

same areas were sampled each time. Procedures used were those decribed in "Big Game Habitat Analysis for New Mexico," an interagency method commonly used in New Mexico big game studies (HMP, BLM 1979). A total of 24 transects were initially read. An additional 4 transects were established in 1981. Transects identified as 18 and 27 were discontinued in 1981. An average of 25 transects were examined over the 7-year period. Each transect consisted of 50 pace points. Transect locations were selected on the basis of occurrence of important browse species (Interagency Habitat Analysis Report, No Date).

Information collected from each area was recorded onto browse transect sheets (Interagency Form #2). Parameters measured were species composition, browse frequency of use, browse age-structure and vigor, and deer, wild goat, and cattle fecal pellet density. Data were reviewed and compared using correlation analysis. Trends also were determined. Means were determined for all conditions for each year. Only the annual means for the 3 "key" browse species (mountain mahogany, Wright's silk tassel, and oak) were compared. A value of $P \leq 0.10$ was considered significant for all statistical analyses.

Transect data also were separated into elavation zones as follows: $\leq$ 6200 feet, between 6200 and 6800 feet, and $\geq$ 6800 feet. There are 8, 9, and 9 transects, respectively, in each zone. Parameter means in the elevation zones were subjected to

the same statistical analysis as stated earlier.

Composition

Species composition was calculated from point contacts for each transect. Each transect observed only 50 plants or points, and each point was considered an encounter. Encounters were recorded for age class and form class for each species. Composistions were determined by doubling each species encountered. The totals of age class and form class had to agree. Average annual composition was estimated by totaling all species encounters over all transects of a given year, doubled, and divided by the total number of transects. Although, more than the key browse species were recorded, only the 3 "key" species' compositions were reveiwed. Compositions of the 3 "key" browse species were determined with the use of all species encountered.

Composition means for the 3 "key" browse species were compared over the 7-year period and at each elevation. Comparisions with other parameters also were examined over time and elevation. These relationships will be discussed in later sections.

Frequency of Use

Average percent frequency of use per transect was estimated for browse species encountered. Total frequency of use (percent of twigs being browsed) for each transect was determined for each species by adding the use factor at each percentage level. Each species' total frequency of use was divided by the number of

plants of that species, estimating average percentage frequency of use. Annual mean percentage frequency of use was determined for each species by dividing the total use from all transects by the total number of plants of that species from all transects.

Annual mean percent of twigs browsed were compared between the 3 "key" browse species over the 7-year period. With the use of scatter diagrams, relationships over time were determined. Correlation coefficients were calculated for all relationships that were significant at a $P \leq 0.10$ level. Frequency of use means also were compared with all other browse conditions for each year and at the different elevation zones.

Age Class

Browse age class was divided into the 4 following classes: young (Y), mature (M), decadent (Dec.), and dead (D). Young are decribed as being less than 10 years old with simple branching. Mature are distinguished by heavier, often knarled stems, complex branching, and rounded growth form. Decadent plant are those which are made up of more than 1/2 deadwood. Dead plants were not considered in calculating composition (Interagency Habitat Analysis Report, No Date).

Average annual age class percentages for a species were determined by dividing the total number of plants in an age class, for all transects, by the total number of plants of that species. Correlations were determined between annual percentage

decadent and/or dead plants and all other browse condition means. Comparisons also were made at different elavation zones.

Form Class

Form class is basically separated into 6 classes: (1) all available, little or no hedging; (2) all available, moderately hedged; (3) all available, severely hedged; (4) partly available, little or no hedging; (5) partly available, moderately hedged; and (6) partly available, severely hedged (Interagency Habitat Analysis Report, No Date).

For this study, only the severely hedged classes (3 and 6) were analysed. Annual percentage of severely hedged was determined by dividing the total number of plants of a species that occurred in classes (3) and (6) by the total number of plants of that species, for all transects. Severely hedged mean percentages for the 3 "key" browse species were compared and correlated with all other parameters over the 7-year period and for the 3 elevation zones. Correlation coeffiecents were calculated.

Fecal Deposition

Ten 0.01-acre (11' 9" radius) fecal group plots were read along each transect while browse condition data were collected. They were read every fifth point along the transect. Only wild goat, deer, and cattle fecal groups were counted. All readily identifiable groups of the current year were counted. Pellet-groups per acre for each transect were determined by totalling the

number of pellet groups of each animal species and multiplying by 10. Annual pellet-groups per acre averages were determined by adding all transect totals and dividing by the number of transects. All pellet-groups yearly means were compared and correlated with browse conditions for the 7-year period and for the 3 elevations zones.

Diets

Food habits data were obtained by collecting wild goat and deer feces. Fecal pellet groups were collected by Woodroof (1979) and BLM personnel in August, September, and December of 1977, March and May of 1978, and January of 1979. Pellet groups were not collected again until 1985. Composite pellet groups were collected from both the north and south ends of the Florida Mountains in October, 1985 and January and February, 1986. Composite pellet groups consisted of 2 samples of 10 groups from both the north and south ends. Each group consisted of an average of 10 pellets. Fecal collections were analysed by the microhistological technique at the food habits laboratory at Colorado State University, Fort Collins, Colorado.

Results from the earlier (1977, '78, '79) and most recent (1985, '86) fecal data were compared to show trends and differences in wild goats' and mule deer's diets. Diets were separated into the categories of "key" browse species, other browse species, forbs, grasses, cactus, and yucca. Annual means were calculated and compared for both wild goats and mule deer.

Precipitation

BLM rainfall data for the Florida Mountains were not complete. Data used in this report came from the climatology office at the Department of Agriculture, New Mexico State University. The precipitation data were increased by 40% by month from rainfall information taken from Columbus, New Mexico. Adjustments were made using a 30-year precipitation map from the U.S. Dept. of Commerce, Environmental Science Services Administration, Weather Bureau (1967). The 30-year average for Columbus, New Mexico was 10 inches annually. The Florida Mountains 30-year average rainfall ranged from 12 to 16 inches annually, depending upon elevation. Since most of the use by wild goats occurred somewhere between the 2 averages, 14 inches was considered average annual rainfall for the range. Means were calculated for adjusted annual, winter (December-February), spring/summer (March-August), summer/fall (June-November) and fall/winter (September-February) precipitation. These means were compared with pellet group and browse condition parameters using scatter diagrams and correlation coefficents.

Aerial Survey Census

Aerial survey data for Persian wild goats were collected annually by personnel from the NMDG&F and BLM. The first aerial survey was conducted in 1972 and the lastest survey was done in 1985. Objectives were to determine population trends, sex and age classification, and distribution. This information was to aid in

determining harvest (Performance Report, NMDG&F 1985) and carrying capacity.

Survey information were reviewed and trends were determined using precent increases. Post-hunt survey censuses were not conducted from 1981 through 1984. Numbers for these years were calculated using averages of percent decreases from known pre- to post-hunt censuses. These numbers were compared to Woodroof's (1979) findings and recommendations. Wild goat numbers also were compared with browse conditions.

Harvest

Wild goat harvest data were collected from 1975 through 1985 by NMDG&F personnel. Hunt strategies were developed using literature from both New Zealand and the United States (Performance Report, NMDG&F 1985). Recommendations from Sutcliffe (1972), Bavin (1975), and Woodroof (1979) also were used. Harvest and survey data were used to determine percentages of harvests and percetnages unexplained losses. Harvest information were reviewed for possible trends.

RESULTS

Vegetation

Composition

Annual percent composition from 1979/80 to 1985/86 varied between the 3 key browse species. Over the 7 years, compositions of mountain mahogany ranged from 27 to 33% with the highest percentage occurring in 1982/83. Wright's silk tassel was encountered more frequently during the 1979/80 sample period. Annual compositions ranged from 6 to 9% for this species. Annual oak composition ranged from 23 to 39% with the highest occurring in 1984/85 (Table 1). Compositions of the 3 browse species over the study period averaged 29, 7, and 33%, respectively, for mountain mahogany, Wright's silk tassel, and oak. Included in Table 1 are combined annual compositions of the 3 browse species. Combined compositions ranged from 60 to 77%, averaged 69% and were highest in 1982/83 (Table 1).

Combined compositions separated into the 3 elevation zones resulted in percentages from 45 to 69% at $\leq$ 6200 feet, 65 to 86% between 6200 and 6800 feet, and 62 to 84% at $\geq$ 6800 feet (Table 2). Average annual compositions over 7 years on the 3 elevation zones for mountain mahogany were 17, 41, and 28%, respectively, with increasing elevation. Represented in the same order, compositions of Wright's silk tassel were 9, 6, and 8%. Compositions of oak on increasing elevation zones were 28, 31, and 39%. Compositions of mountain mahogany were higher on the

Table 1. Annual percent composition of 3 key browse species on the Florida Mountains, 1979 through 1986.

Year	Species	No. of Plants	x2	No. of Transect	App. % Comp
79-80	Cemo.	339	678	24	28
	Gawr.	108	216	24	9
	Querc.	277	554	24	23
	Total				60
80-81	Cemo.	335	670	23	29
	Gawr.	91	182	23	8
	Querc.	345	690	23	30
	Total				67
81-82	Cemo.	369	738	27	27
	Gawr.	93	186	27	7
	Querc.	471	942	27	35
	Total				69
82-83	Cemo.	427	854	26	33
	Gawr.	107	214	26	8
	Querc.	473	946	26	36
	Total				77
83-84	Cemo.	340	680	25	27
	Gawr.	82	164	25	7
	Querc.	430	860	25	34
	Total				68
84-85	Cemo.	366	732	25	29
	Gawr.	86	172	25	7
	Querc.	492	984	25	39
	Total				75
85-86	Cemo.	383	766	26	29
	Gawr.	84	168	26	6
	Querc.	448	896	26	34
	Total				69

Table 2. Elevation zone average composition of 3 key browse species on the Florida Mountains, 1979 through 1986.

Species	79-80	80-81	81-82	82-83	83-84	84-85	85-86
	Average percent composition at ≤ 6200 feet						
Cemo.	19	19	15	18	15	19	17
Gawr.	17	9	8	9	6	8	6
Querc.	9	29	23	32	30	42	32
Total	45	57	46	59	51	69	55
	Average percent composition between 6200 and 6800 feet						
Cemo.	41	34	40	43	46	42	42
Gawr.	3	6	6	8	6	6	5
Querc.	25	25	36	35	27	36	36
Total	69	65	82	86	79	84	83
	Average percent composition at ≥ 6800 feet						
Cemo.	22	32	28	35	21	27	28
Gawr.	8	9	7	8	8	7	8
Querc.	32	36	41	41	46	40	35
Total	62	77	76	84	75	74	71

middle elevations than at the 2 other elevation zones. Compositions of Wright's silk tassel were highest in the lowest elevation zone. Oak occurred in more abundance at the highest elevation zone (Table 2).

The number of transects which actually contained the different species varied slightly. During the study period transects with mountain mahogany ranged from 19 to 24. Wright's silk tassel was present on 20 to 24 transects. Transects containing oak ranged from 18 to 27 (Table 1).

Frequency of Use

Annual average percentage of twigs browsed for mountain mahogany ranged from 18 to 60% with a 7-year mean of 32%. Browsing on Wright's silk tassel twigs exceeded 40% every year except 1985/86. The 7-year average for this species was 51% with a range from 31 to 75%. Browsed twigs of oak averaged 11% and ranged from 5 to 23% (Table 3).

The different percentages of twigs browsed, separated into 3 elevation zones, are in Table 4. Mountain mahogany frequency of use averaged 32, 28, and 36%, respectively, with increasing elevation. Frequency of use of Wright's silk tassel was highest, averaging 52%, at $\geq$ 6800 feet. At $\leq$ 6200 and between 6200 and 6800 feet, average frequency of use was 47 and 44%, respectively. Oak showed relatively the same frequency of use with only a 1 to 2% difference for all 3 elevation zones. The highest average

Table 3. Annual mean percent frequency of use of 3 key browse species on the Florida Mountains, 1979 through 1986.

Year	Species	Total Util.	No. of Plant	Ann. $\bar{X}$ % Util.
79-80	Cemo.	11360	339	34
	Gawr.	4700	108	44
	Querc.	1590	277	6
80-81	Cemo.	8850	335	26
	Gawr.	3720	91	41
	Querc.	4270	345	12
81-82	Cemo.	11680	369	32
	Gawr.	5580	93	60
	Querc.	5700	471	12
82-83	Cemo.	25480	427	60
	Gawr.	7993	107	75
	Querc.	10958	473	23
83-84	Cemo.	6740	340	*20(26)
	Gawr.	3010	82	*37(57)
	Querc.	3200	430	*7(7)
84-85	Cemo.	11040	366	30
	Gawr.	4210	86	49
	Querc.	5730	492	12
85-86	Cemo.	6860	383	18
	Gawr.	2610	84	31
	Querc.	2210	448	5

* Transects were re-read and numbers in paretheses are the results. These numbers were used in all calculations.

Table 4. Elevation zone average frequency of use of 3 key browse species on the Florida Mountains, 1979 through 1986.

Species	79-80	80-81	81-82	82-83	83-84	84-85	85-86
	Average percent frequency of use at ≤ 6200 feet						
Cemo.	35	30	31	64	19	29	19
Gawr.	40	43	55	87	29	55	19
Querc.	9	11	15	23	5	9	7
	Average percent frequency of use between 6200 and 6800 feet						
Cemo.	28	29	28	63	19	19	8
Gawr.	38	53	54	68	35	36	27
Querc.	6	21	11	26	7	11	3
	Average percent frequency of use at ≥ 6800 feet						
Cemo.	38	22	37	53	23	47	33
Gawr.	54	31	69	69	43	53	44
Querc.	4	6	12	21	9	15	5

frequency of use (12%) occurred between 6200 and 6800 feet.

Age class

The highest percentage (4%) of mountain mahogany classified as young over the 7 years occurred in 1980/81 and 1981/82. Mature plants ranged from 83 to 91% and averaged 86%. Decadent mountain mahogany percentages ranged from 6 to 12% and averaged 9%. In 1981, 8% were classified as dead. This was the highest percentage over 7 years. Dead plants ranged from 2 to 8% with a mean of 3%. Over the 7-year study period, from 8 to 13% of sampled plants were considered decadent and/or dead. Calculations and annual mean percentages are given in Table 5.

Only 3 young Wright's silk tassel plants, averaging <1%, were observed over the 7-year study period. The percentages of Wright's silk tassel classified as mature ranged from 65 to 85% and averaged 76%. Decadent and dead plants combined made up 15 to 35% of the age structure over 7 years. Separately, decadent plants averaged 19%, and dead plants averaged 4% (Table 5).

In 1982, 9% of oak were classified as young. Young plants made up <1 to 9% of the age structure over 7 years. Oak had the highest percentages of mature plants of the 3 key browse species. Mature plant percentages ranged from 88 to 98% and averaged 94%. Oak also had the lowest percentages of decadent and/or dead plants of the 3 species with a range of <1 to 7%. The average of decadent oak plants was 3%. An average of 1% of oak plants were considered dead (Table 5).

Table 5. Annual age structure expressed as numbers and percentages( ).

Species	Age	79-80	80-81	81-82	82-83	83-84	84-85	85-86
	[1]Y	5(1)	14(4)	15(4)	7(2)	10(3)	4(1)	9(2)
	[2]M	313(91)	303(83)	311(83)	373(85)	288(83)	330(88)	346(88)
Cemo.	[3]De	21(6)	18(5)	43(11)	47(11)	42(12)	32(8)	28(7)
	[4]Dd	6(2)	32(8)	9(2)	10(2)	7(2)	11(3)	13(3)
	[5]*	(8)	(13)	(13)	(13)	(14)	(11)	(10)
	Y	1(1)	1(1)	0	1(1)	0	0	0
	M	89(78)	78(84)	64(65)	80(73)	57(66)	79(85)	71(80)
Gawr.	De	18(16)	12(13)	29(30)	26(24)	25(29)	7(8)	13(15)
	Dd	6(5)	2(2)	5(5)	2(2)	4(5)	6(7)	4(5)
	*	(21)	(15)	(35)	(26)	(34)	(15)	(20)
	Y	7(2)	6(2)	41(9)	6(1)	8(2)	2(<1)	2(<1)
	M	265(95)	336(97)	419(88)	451(95)	392(88)	482(97)	444(98)
Querc.	De	5(2)	3(<1)	11(2)	16(3)	30(7)	8(2)	2(<1)
	Dd	1(<1)	3(<1)	4(1)	2(1)	16(3)	5(1)	4(1)
	*	(2)	(1)	(3)	(4)	(10)	(3)	(1)

[1]Y-Young

[2]M-Mature

[3]De-Decadent

[4]Dd-Dead

[5]*-Combined percentages decadent and dead

Age structure for the key browse species were separated into 3 elevation zones (Table 6). All 3 browse species had the highest mean percentage of mature plants at $\leq$ 6200 feet. Mean mature percentages at this elevation were 95, 82, and 94%, respectively, for mountain mahogany, Wright's silk tassel, and oak. Decadent percentages increased for the 3 species with increasing elevation. Mean percentages of decadent mountain mahogany were 4, 9, and 10%, respectively, at $\leq$ 6200 feet, between 6200 and 6800 feet, and at $\geq$ 6800 feet. Wright's silk tassel mean decadent percentages were 15, 17, and 23% with the highest occurring at $\geq$ 6800 feet. With increasing elevation zones, oak means were .9, 2, and 4%. Young and dead age structure percentages varied with elevation as shown in Table 6.

Form Class

Percentages of mountain mahogany that were severely hedged averaged 32% with the highest percentages occurring in 1982/83. Percentages ranged from 19 to 46%. Percentages of hedged mountain mahogany were greatest from 1981/82 through 1984/85 showing over 30% severely hedged. Severely hedged percentages of under 40% only occurred for Wright's silk tassel during 1980/81 and 1985/86. Severe hedging percentages ranged form 22 to 63% for Wright's silk tassel and averaged 44%. The highest annual percentage of oak that was severely hedged occurred in 1983/84. Severely hedged oak ranged form 1 to 12% and the mean over the 7-year study period was 6% (Table 7).

Table 6. Age structure expressed as percentages as related to elevation of 3 key browse species on the Florida Mountains, 1979 through 1986.

Species	Age	Elevation < 6200'	Between 6200-6800'	>6800'
	[1]Y	.29	4	.86
	[2]M	95	81	87
Cemo.				
	[3]De	4	9	10
	[4]Dd	.71	4	2
	Y	0	.43	.86
	M	82	78	71
Gawr.				
	De	15	17	23
	Dd	3	3	6
	Y	4	1	3
	M	94	94	93
Querc.				
	De	.86	2	4
	Dd	.86	2	.86

[1]Y-Young

[2]M-Mature

[3]De-Decadent

[4]Dd-Dead

Table 7. Severely hedged percentages for the 3 key browse species in the Florida Mountain, 1979 through 1986.

Year	Species	No. in classes 3 and 6 [1]	Total Plant No.	% S.H. [2]
79-80	Cemo.	90	339	27
	Gawr.	43	108	40
	Querc.	4	277	1
80-81	Cemo.	64	335	19
	Gawr.	20	91	22
	Querc.	14	345	4
81-82	Cemo.	130	369	35
	Gawr.	59	93	63
	Querc.	17	471	4
82-83	Cemo.	197	427	46
	Gawr.	49	107	46
	Querc.	39	473	8
83-84	Cemo.	153	340	45
	Gawr.	49	82	60
	Querc.	51	430	12
84-85	Cemo.	113	366	31
	Gawr.	47	86	55
	Querc.	55	492	11
85-86	Cemo.	78	383	20
	Gawr.	20	84	24
	Querc.	3	448	1

[1] 3 and 6-Represent only severely hedged plants

[2] S.H.-Severely Hedged

Severely hedged percentages separated into elevation zones for the 3 browse species resulted in higher average annual means over 7-years at $\geq$ 6800 feet for all 3 browse species. Mountain mahogany showed the same mean percentage (26%) at both $\leq$ 6200 feet and between 6200 and 6800 feet. At $\geq$ 6800 feet an average of 44% was severely hedged. Mean percentages severely hedged of Wright's silk tassel with increased elevation were 41, 37, and 50%, respectively. Oak showed slightly increasing severely hedged percentages with increased elevation (Table 8).

Fecal Deposition

Annual fecal groups per acre for cattle were highest in 1982/83. Cattle fecal groups ranged from 8 to 25 per acre with a 7-year mean of 16. Mule deer fecal groups ranged from 18 to 98 per acre with a mean of 48. The most groups were observed in 1984/85. The 7-year mean for wild goat fecal groups was 139 per acre and ranged from 84 to 250 per acre. The greatest number counted was in 1982/83 (Table 9).

Fecal depositions at different elevation zones are shown in Table 10. Mean cattle fecal groups per acre over 7 years occurred in more abundance at $\leq$ 6200 feet. Density of fecal groups for cattle ranged from 23 to 64 per acre in this zone. An average of 4 fecal groups per acre were counted between 6200 and 6800 feet and at $\geq$ 6800. Middle elevation and high elevation zones showed fecal groups for cattle ranged from 1 to 16 per acre and 0 to 15 per acre, respectively (Table 10).

Table 8. Elevation zone average percent severely hedged of 3 key browse species on the Florida Mountains, 1979 through 1986.

Species	79-80	80-81	81-82	82-83	83-84	84-85	85-86
	Average % severely hedged at ≤ 6200 feet						
Cemo.	12	13	34	44	23	45	12
Gawr.	44	19	57	51	56	53	8
Querc.	0	2	4	8	8	4	1
	Average % severely hedged between 6200 and 6800 feet						
Cemo.	25	17	24	51	46	10	6
Gawr.	38	22	69	43	41	35	13
Querc.	0	6	2	10	7	11	0
	Average % severely hedged at ≥ 6800 feet						
Cemo.	37	24	52	41	57	51	48
Gawr.	30	24	64	43	74	71	43
Querc.	2	3	5	7	17	18	1

Table 9. Fecal deposition means for cattle, mule deer, and wild goats on the Florida Mountains, 1979 through 1986.

Year	Animal	Total. No. fecal Groups	No. of Trans.	Mean Fecal-Gr/A
	Cattle	230	24	10
79-80	Deer	960	24	40
	W. Goat	2270	24	95
	Cattle	510	23	22
80-81	Deer	620	23	27
	W. Goat	3100	23	135
	Cattle	224	28	8
81-82	Deer	1176	28	42
	W. Goat	3024	28	108
	Cattle	650	26	25
82-83	Deer	2350	26	90
	W. Goat	6490	26	250
	Cattle	420	25	17
83-84	Deer	500	25	20
	W. Goat	4050	25	162
	Cattle	380	25	15
84-85	Deer	2450	25	98
	W. Goat	3520	25	141
	Cattle	380	26	15
85-86	Deer	470	26	18
	W. Goat	2180	26	84

Table 10. Mean fecal groups per acre by elevation zones for cattle, mule deer, and wild goats on the Florida Mountains, 1979 through 1986.

Animal	79-80	80-81	81-82	82-83	83-84	84-85	85-86
	Average pellet groups/acre at ≤ 6200 feet						
Cattle	23	42	13	64	48	46	44
Deer	73	83	66	139	46	86	29
W. Goat	63	42	66	185	48	45	26
	Average pellet groups/acre between 6200 and 6800 feet						
Cattle	1	16	0	7	0	1	3
Deer	28	0	61	107	8	108	12
W. Goat	129	147	90	323	179	131	44
	Average pellet groups/acre at ≥ 6800 feet						
Cattle	0	15	3	9	1	0	0
Deer	15	15	14	31	8	100	14
W. Goat	98	193	187	233	249	234	174

Mule deer mean fecal groups per acre decreased with increased elevation. For the 3 elevation zones fecal group means were 75, 46, and 16 per acre with increasing elevation. Fecal groups per acre for mule deer ranged from 29 to 139, at $\leq$ 6200 feet, 0 to 108 between 6200 and 6800 feet, and 8 to 100 at $\geq$ 6800 feet (Table 10).

Wild goat fecal group means over 7 years increased with increasing elevation. Fecal groups ranged from 26 to 185 and averaged 68 per acre at $\leq$ 6200 feet. The 7-year average between 6200 and 6800 feet was 149 groups per acre and ranged from 90 to 323 per acre. At $\geq$ 6800 feet the range was from 98 to 249 groups per acre and averaged 195 per acre (Table 10).

Diets

Food habits data and results for mule deer (Table 11) and wild goats (Table 12) show mountain mahogany, Wright's silk tassel, and oak were comprising the greatest amount of forage for both ungulates. The 3 browse species made up an average of 77.8% of the mule deer's diets and 76.2% of the wild goats' diets from data collected in 1977, 1978, and 1979. Average mule deer diets were comprised of 37.0% mounatin mahogany, 31.2% Wright's silk tassel, and 9.6% oak. Wild goat diets were comprised of an average of 27.6, 36.2, and 12.4%, respectively, of mountain mahogany, Wright's silk tassel, and oak over the 3-year period. Cactus made up the next highest percentage of mule deer diets with an average of 9.2%. Total browse species comprised 86.8% of

Table 11. Fecal analysis results expressed as percentages for mule deer on the Florida Mountains, 1977 through 1979.

	Means			
Species	1977	1978	1979	Over all Avg.
Cemo.	14.0	51.3	54.5	37.0
Gawr.	42.3	22.7	26.0	31.2
Querc.	4.8	18.1	2.3	9.6
Total	61.1	92.1	82.8	77.8
Other Browse	15.3	5.2	4.1	9.0
Forbs	3.3	1.8	0.6	2.1
Grass	2.9	0.5	2.4	1.8
Cactus	17.4	0.4	10.2	9.2
Total Browse	76.5	97.3	86.9	86.8
Other	23.6	2.7	13.1	13.1

Table 12. Fecal analysis results expressed as percentages for wild goats on the Florida Mountains, 1977 through 1979 and 1985-86.

	Means				
Species	1977	1978	1979	3-Year Avg.	Avg. 1985-86
Cemo.	22.1	24.5	47.5	27.6	66.2
Gawr.	37.3	38.6	26.5	36.2	9.0
Querc.	10.5	15.3	7.8	12.4	15.7
Total	69.8	78.4	81.7	76.2	90.9
Other Browse	24.6	10.4	11.6	15.3	2.7
Forbs	1.6	1.4	3.4	1.8	.6
Grass	2.5	5.0	1.0	3.5	2.6
Yucca	0	0	0	0	1.1
Cactus	1.5	4.6	2.5	3.2	1.7
Fern	.2	.1	0	.1	.6
Total Browse	94.4	88.8	93.3	91.5	93.6
Other	5.6	11.2	6.7	8.6	6.4

mule deer's diets, while other forage types made up an average of 13.1%. All other browse species combined made up 15.3% of wild goats' diets. Wild goats' diets were comprised of an average of 91.5% browse and 8.6% of other forage types.

No data were collected pertaining to mule deer diets in the Florida Mountains after 1979. Data collected in 1985 and 1986 showed the 3 browse species comprised 90.9% of the wild goats' diets. Total browse made up 93.6% and other forage types comprised 6.4% of wild goats' diets for these years.

Precipitation

Precipitation data were adjusted from information collected for Columbus, New Mexico from years 1979 through February, 1986. Annual precipitation on the study area was highest in 1985 with over 21 inches. The lowest occurred in 1980 with just under 11 inches. Five years were estimated as having 14 inches or more. Spring/summer (March-August) precipitation ranged form 1.4 to 11.2 inches. Summer/fall (June-November) rainfall accounted for the highest percentage over 7 years. In 5 of the 7 years, summer/fall rainfall comprised more than 70% of the annual precipitation (Table 13).

Table 13 also shows precipitation separated into winter and fall/winter (September-February) categories. Winter precipitation ranged from 1.2 to 6.5 inches with the highest occurring in 1982/83 and the lowest occurring in 1983/84.

Table 13. Adjusted precipitation from Columbus, New Mexico for the Florida Mountains, 1979 through 1986.

Year	Win.	Fall/ Win.	Year	Spr./ Sum.	Summ./ Fall	Annual
79-80	2.4	3.8	79	10.7	11.7	14.5
80-81	3.0	6.3	80	5.5	7.7	10.9
81-82	1.7	6.8	81	8.3	9.6	15.7
82-83	6.5	9.3	82	1.4	4.0	11.0
83-84	1.2	7.2	83	6.4	10.1	14.0
84-85	6.1	12.4	84	11.2	16.4	21.8
85-86	1.2	7.2	85	10.2	13.5	19.1

Table 14. Aerial census information for the Persian wild goats on the Florida Mountains, 1977 through 1985.

Year	Pre-Hunt Survey	Percent Increase	Post-Hunt Survey	Percent Increase
1977	147	-	113	-
1978	-	-	-	-
1979	208	29	118	4
1980	334	38	178	34
1981	432	23	*259	31
1982	537	20	*322	20
1983	647	17	*388	17
1984	696	7	*418	7
1985	1020	32	532	21

*-Extrapolated

Fall/winter precipitation ranged from 3.8 to 12.4 inches. Every fall/winter period except 1979/80 showed more than 6 inches of precipitation.

Aerial Survey Census

Woodroof (1979) projected for 1984 a female wild goat population made up of 219 to 314 animals. The NMDG&F counted 316 females in that year's aerial survey census (Performance Report, NMDG&F 1984). In 1985, 499 females were counted by the NMDG&F. Woodroof's projected numbers were from 254 to 377.

The 1977 pre-hunt survey showed 147 wild goats on the Florida Mountains. The post-hunt survey totaled 113 wild goats. By 1984 census numbers were 696 and 418, respectively, for the pre- and post-hunt aerial surveys. Wild goats counted in 1985 increased to 1020 in the pre-hunt and 532 in post-hunt aerial surveys. Percent increases from previous years ranged form 7 to 38% in the pre-hunt surveys and from 4 to 34% in the post-hunt surveys. The highest percentage increase occurred in 1980 for both pre-hunt and post-hunt surveys (Performance Report, NMDG&F 1984). Post-hunt census numbers for 1981 through 1984 were extrapolated from an average of pre-hunt and post-hunt differences (Table 14).

Harvest

Harvest information for the Florida Mountains (Table 15) show 12 licenses were used in 1977 and 9 male wild goats were harvested. In 1985, 524 licenses were used and 135 males and 112 females

Table 15. Harvest information for the Persian wild goat on the Florida Mountains, 1977 through 1985.

Year	Total Animals	Lic. Used	Hunt Harvest	% of Total	[1]No. Unexpl. Loss	% of Total
1977	147	12	9	6	25	17
1979	208	20	12	6	78	38
1980	334	19	15	4	141	42
1981	432	65	40	9	133	31
1982	537	159	94	18	121	23
1983	647	229	118	18	141	22
1984	696	240	187	27	91	13
1985	1020	524	247	24	241	24

[1] Calculated from pre- and post-hunt census data in Table 14.

were taken. Assuming survey censuses were accurate, percentages of the population that were harvested ranged from 4% in 1980 to 27% in 1984. Unexplained losses ranged from 25 animals (17%) to 241 animals (24%). The highest percentage of unexplained losses (42%) occurred in 1980, and the lowest (13%) occurred in 1984.

DISCUSSION

Vegetation

For 7 years, browse conditions have been determined on the Florida Mountains using techniques which were originally designed to show range trend. In the case of the Florida Mountains, trend data are only going to assess what's occurring to the vegetation community in a given area over time. Current sampling systems provide only a measure of relative use of areas over the 7-year period and are not capable of determining specific condition differences of individual browse plants on a yearly basis. The browse transects were established and read in general areas and were not repeated for the same plants on a year-to-year basis. Such a procedure places limitations on statistical analysis which would determine differences of individual plant conditions from year to year. Statistical analyses of compositon, frequency of use, age class, and form class are comparing trends over a 7-year period for a given area and not differences in individual plant species or transects on a yearly basis. Since these statistical limitations exist, only correlations between different browse conditions and over time were determined. Statistical differences between means and analysis of variance for the data collected would be unsound and were not determined.

Composistion

Annual combined compositions of the 3 key species ranged from 60

to 77%. Percentage change in combined composition of these 3 species averaged 12% over the 7 years. Separately, oak compositions show the highest year-to-year variation, averaging 14% over 7 years. Annual variations of Wright's silk tassel averaged 11%, while mountain mahogany averaged 10% over 7 years. This information may be indicating actual composition variation, sampling error from year to year, bias between observers, or a combination of factors. Considering that different transects were run in the same area each year, this information may not actually be showing composition variation but rather showing sample variation form year to year. However, there was no consistent increase or decrease in plant numbers encountered and the data probably are showing a stable browse population.

Significant correlations were observed only when comparing combined compositions of the 3 browse species with wild goat survey numbers, average wild goat fecal groups per acre, and average mule deer fecal groups per acre. All 3 comparisons showed positive relationships and were significant ($P<0.10$). The degree of association or correlation coefficients (r) for the relationship of combined compositions and average pellet groups per acre was 0.69 and 0.71, respectively, for wild goats and mule deer. The positive relationship between combined browse compositions and wild goat survey numbers had a correlation coefficient of 0.75. These comparisons suggest wild goats and mule deer showed a preference for areas having higher combined compositions of the 3 browse species. These correlations do not

show any detrimental impact for mule deer and wild goat populations.

Frequency of Use

Comparisons of frequency of use (percentage of twigs browsed) among the 3 browse species were all directly related. Average use for mountain mahogany and Wright's silk tassel were significantly correlated ($P<0.02$, $r=0.84$). Use of oak was significantly correlated to use of mountain mahogany ($P<0.02$, $r=0.87$) and use of Wright's silk tassel ($p<0.05$, $r=0.79$). In effect, as 1 species' average frequency of use increased so did frequency of use of the others. This does not suggest that 1 species is preferred over the other but simply shows heavier browsing on all species. The implication that use of 1 species is dependent on the other 2 or vice versa cannot be determined from these analyses.

Figure 2 illustrates average frequency of use over the 7-year study period. The average frequency of use of Wright's silk tassel was always greater than mountain mahogany which was always greater than oak. Average frequency of use of the 3 browse species basically increased for 4 years of the study and decreased for the latter 3 years.

AUFs for mountain mahogany, Wright's silk tassel, and oak were set at 60, 40, and 25%, respectively, by the BLM in 1979. A concern with AUFs was that allowable use refers to the amount

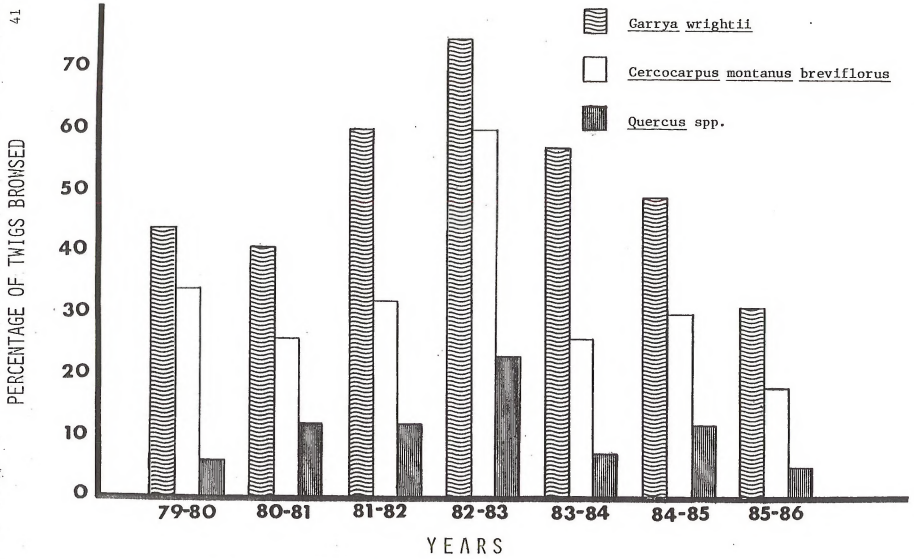


Figure 2. Average annual percentages frequency of use of 3 key browse species on the Florida Mountains, 1979 to 1985.

of the current year's growth that can be removed and not to frequency of use as is the case with data from the Florida Mountains. Accurate determinations of current year's production and the amount which is removed by browsing would estimate whether allowable use has been met. Lack of research data on allowable use of Wright's silk tassel and oak species makes it difficult to evaluate the validity of AUFs for these plants. There is, however, some information relating to allowable use of mountain mahogany.

Neff (1970), after 10 years of clipping at intensities 0, 25, 50, 75, and 100% concluded mountain mahogany could withstand grazing use of 75% or less of the current year's growth without loss of vigor "for considerable periods of time". He also stated that mountain mahogany could probably withstand higher amounts of use for intermittent short periods. This study agreed with a study by Shephard (1970) who estimated optimum use of mountain mahogany to be about 70% of current growth. Mountain mahogany production was increased with heavier levels of clipping (50-60%), while lower clipping intensities (0-25%) produced stagnation of growth (Neff 1970). Neff's (1970) report also stated that browse growth in each season was dependent upon current precipitation, and growth was not influenced by the preceeding year's precipitation.

Form Class

Average percentages of severely hedged mountain mahogany was correlated with percentages of severely hedged Wright's silk

tassel ($P<0.05$, $r=0.77$) and oak ($P<0.10$, $r=0.70$). Annual average percentages of severely hedged mountain mahogany also were correlated with combined percentages of decadent and dead mountain mahogany ($P<0.10$, $r=.75$). As higher amounts of mountain mahogany showed severe hedging, higher amounts of both Wright's silk tassel and oak showed severe hedging. With increased percentages of severely hedged mountain mahogany, there also were increased amounts of combined decadent and dead mountain mahogany, as one might expect. No significant relationships were found when comparing average frequency of use and percentages of severe hedging of any of the 3 browse species. This further indicates that the frequency of browsing data were not providing an accurate estimate of allowable use.

Severely hedged plants are those which show heavy use from the past several years causing a clumped or broomed appearance (Interagency Habitat Analysis Report, No date). As shown in Figure 3 average percentages of severely hedged plants fluctuated more readily than did average frequency of use (Figure 2). The percentages of Wright's silk tassel and mountain mahogany which were classified as severely hedged from 1981/82 through 1984/85 averaged 30 to 45%. During the last 2 years of study the percentages of frequency of use and hedging were found to have decreased, while wild goat numbers increased. Higher amounts of precipitation may be 1 factor which might explain this decreased frequency of use and increased vigor of the 3 browse species. Estimated precipitation was over 19 inches for the last

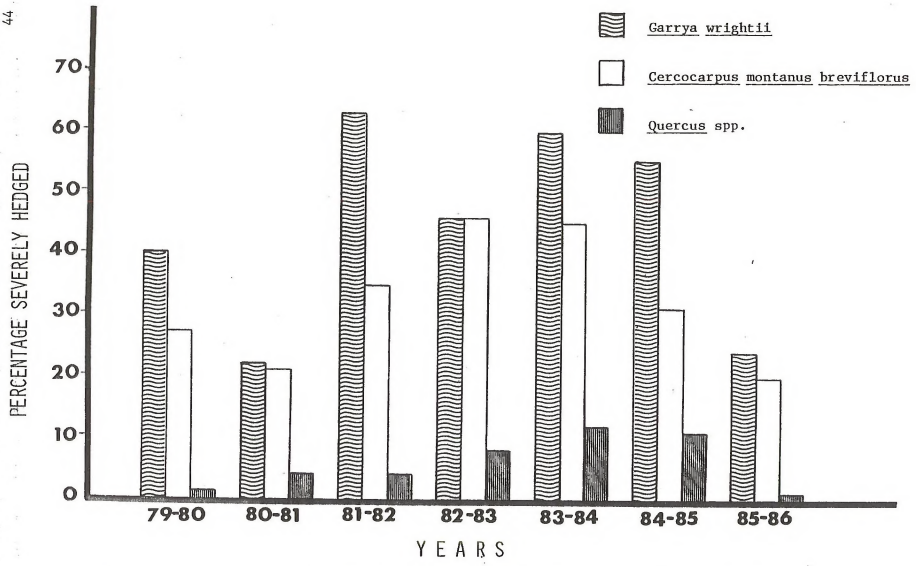


Figure 3. Average annual percentages of 3 key browse species that were classified as severely hedged on the Florida Mountains, 1979 to 1985.

2 years. Increased precipitation is known to considerably increase forage production. With possible increased forage production, the observed average frequency of use would normally decrease and vigor would increase.

Fecal Deposition Relationships

Mean numbers of fecal groups per acre for wild goats were found to be directly and significantly correlated ($P<0.05$) with average annual frequency of use of both mountain mahogany ($r=0.82$) and Wright's silk tassel ($r=0.80$). Annual average frequency of use of oak was directly correlated to average wild goat fecal groups per acre ($P<0.02$, $r=0.85$). As would be expected, as fecal groups per acre increased annual average frequency of use of the 3 key browse species increased. Average fecal groups per acre for wild goats also were correlated with average severely hedged percentages for mountain mahogany ($P<0.10$, $r=0.73$).

Numbers of fecal groups per acre for mule deer were correlated with average percent frequency of use of mountain mahogany ($P<0.10$, $r=0.68$). Numbers of fecal groups per acre for mule deer were not correlated to any other vegetative condition factors on a yearly basis. This information supports earlier diet data where mountain mahogany made up the highest percentage of mule deer's diets.

Average fecal groups per acre for wild goats, mule deer, and cattle (Figure 4) showed a trend similar to the average frequency

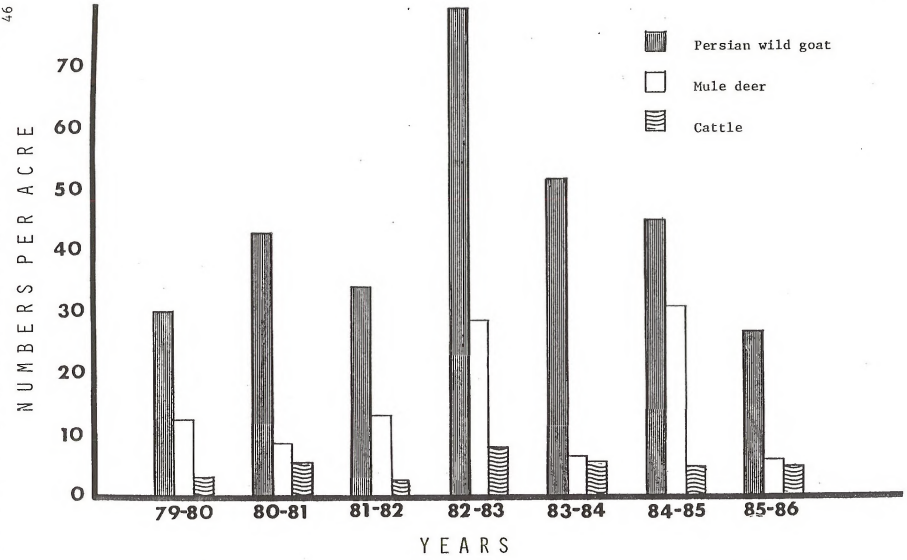


Figure 4. Average annual number of fecal groups per acre of 3 ungulates on the Florida Mountains 1979 to 1985.

of use trend over 7 years. Fecal groups per acre increased for 4 years and decreased for the next 3 years. One exception to this trend was in 1984/85 when fecal groups per acre for mule deer were highest.

By 1982/83 wild goat numbers had increased to 647 animals (Table 14). The most fecal groups per acre for wild goats were observed in that period. Mule deer and cattle fecal groups also were found in high abundance in 1982/83. During that period, frequency of use and combined compositions were high, shrub vigor was poor, and annual adjusted precipitation was below the average. Since browse transects were originally established in selected high use areas and precipitation (11 inches) was below the average, animals may have been concentrating in these areas. With precipitation being low, forage production probably was lower than during average rainfall years. A combination of these factors may have concentrated animals in areas where forage was in greatest abundance, and resulted in higher counts of fecal groups per acre and higher frequency of browse use in these preferred areas.

Precipitaion Relationships

Adjusted annual rainfall was found to have no relationship with any browse condition or fecal group factors. Adjusted winter precipitation showed a positive correlation with both average annual percentage of frequency of use of mountain mahogany and oak. Relationships were significant at the $P<0.10$ and $P<0.05$

levels, respectively, for mountain mahogany (r=0.71) and oak (r=0.79). As winter precipitation increased average frequency of use of mountain mahogany and oak increased. Summer/fall rainfall and average annual frequency of use of mountain mahogany showed a negative correlation ($P<0.10$, $r=-0.67$). When summer/fall rainfall decreased average frequency of use of mountain mahogany increased. This relationship is probably the result of animals using certain areas more than others when rainfall is low. These areas are likely to have a higher abundance of desirable forage species such as mountain mahogany. Since the browse transects were located in these areas, mountain mahogany would tend to show more evidence of browsing.

Adjusted winter precipitation showed a positive correlation to both wild goat and mule deer average fecal groups per acre. The correlation between wild goat fecal groups per acre and winter precipitation was significant ($P<0.10$, $r=0.69$). The correlation between mule deer fecal groups per acre and winter precipitation was highly significant ($P<0.01$, $r=0.95$). Above average winter precipitation appeared to concentrate wild goats and mule deer in high use areas.

Relationships in Elevation Zones

$\leq$ 6200 Feet

Oak was the most abundant species at $\leq$ 6200 feet making up an average 30% of the plant species. Combined compositions of the 3

browse species were lowest in this elevation zone. Wright's silk tassel showed the highest percentages of frequency of use and the greatest degree of severely hedged plants of the 3 browse species. There were more mature and fewer decadent and dead plants in this elevation zone than in the other zones. Numbers of wild goats (68) and mule deer (75) fecal groups per acre in this zone were similar to cattle fecal groups (40) per acre as compared to other zones. Percentages of frequency of use and hedging probably can be attributed to all 3 animal species since none of them seemed to be occupying this elevation zone significantly more than the others. A high correlation was found between average percentage frequency of use of mountain mahogany and numbers of wild goat ($P<0.001$, $r=0.96$) and mule deer ($P<0.01$, $r=0.94$) fecal groups per acre.

Between 6200 and 6800 Feet

Frequency of use of oak was greatest in the zone between 6200 and 6800 feet. Except for oak, middle elevations showed the lowest percentages of severe hedging. Average frequencies of use were at their lowest percentages for mountain mahogany and Wright's silk tassel in this zone. The greatest abundance of mountain mahogany and oak occurred at these elevations and the combined composition for the 3 key browse species also was highest. The fact that frequency of use of mountain mahogany and Wright's silk tassel were lower in this elevation zone may be contributed to higher combined browse composition. With higher compostion,

frequency of use and severe hedging will be lower if animal density is not significantly increased. The average fecal groups per acre for wild goats were higher then those for mule deer and cattle. Average fecal groups per acre for mule deer and cattle decreased while wild goats' fecal groups increased when compared to the lower elevation zone. Wild goats probably were responsible for much of the use that occurred in this elvation zone.

$\geq$ 6800 Feet

At $\geq$ 6800 feet browse use condition parameters were highest. The percentage composition for oak was highest at these upper elevations. Oak was the only species whose compositions increased with increased elevation. Combined percentages of decadent and dead plants for the 3 browse species were highest in this elevation zone. Fecal depositions for wild goats were highest in this elevation zone while numbers of fecal groups per acre for mule deer and cattle continued to decrease as compared to lower elevation zones. Frequency of use and severe hedging in this zone probably was due to higher numbers of wild goats.

Fecal deposition data show wild goats generally prefer higher elevations over lower elevations. Average fecal groups per acre for wild goats increased with increasing elevation except in 1982/83. These areas provide the most habitat for escape, resting and bedding, and breeding. Higher elevations also provide better views of surrounding areas.

Diets

Browse species comprised averages of 86.9 and 91.5% of mule deer's and wild goats' diets, respectively, from 1977 through 1979. The 3 key browse species made up over 75% of these figures. No further data for mule deer were collected after 1979. Wild goats' diets showed increased percentages, to nearly 94%, of total browse in 1985/86. Increased consumption of mountain mahogany and oak was observed in 1985/86. Consumption of Wright's silk tassel decreased. The key browse species are evidently becoming even more important to the wild goat population on the Florida Mountains. Reasons for decreased consumption of Wright's silk tassel may be due to decreased percentage compostion of this browse species for the last 3 years. Other forage types, including browse other than the 3 key species, did not increase in wild goats' diets. With increased precipitation over the last several years, increased use of forbs would be expected. Diet data do not reveal forbs becoming more important in wild goats' diets. From 1977 through 1986, 7 different months of diet information were represented. Seasons included were spring, fall and winter. During these seasons the 3 key browse species contributed the majortiy of vegetation consumed by both mule deer and wild goats. The 3 key browse species contributed 57.8% (September of 1977) to 93.4% (October of 1985) of wild goats' diets. During the years with lower percentages of the 3 key browse species, other browse species comprised higher amounts of wild goats' diets. The most any

other vegetation type, other than shrub species, contributed to wild goats' diets was 10.7% of cactus species in March, 1978. There may be, however, seasonal prefrences for certain vegatation types that are not represented in these data and should be investigated.

Wild goats' diets were compared between the north and south ends of the Florida Mountains with fecal samples collected in October, 1985 and January and February, 1986. A comparison of the means between the north ($\bar{x}$=93.9) and south ($\bar{x}$=87.8) ends showed no significant difference ($0.100<P<.250$) between percentages of the 3 key browse species in wild goats' diets. These data may not be a true representation since only 2 samples were collected from both the north and south ends.

Population Status

Numbers of wild goats have increased at an average rate of 24% over the last 8 years. The last pre-hunt aerial survey census (September, 1985) showed 1020 wild goats. The last post-hunt census (December, 1986) showed 532 wild goats. Jimmy Gonzales (NMG&F, Personal Communication 1986) has said they do not know what percentage of the population is actually being censused. Census numbers may be an over- or under-estimation of the actual population numbers. However, personnel from the NMDG&F do not believe they are double counting animals.

Figure 5 shows wild goat population changes from pre- and post-

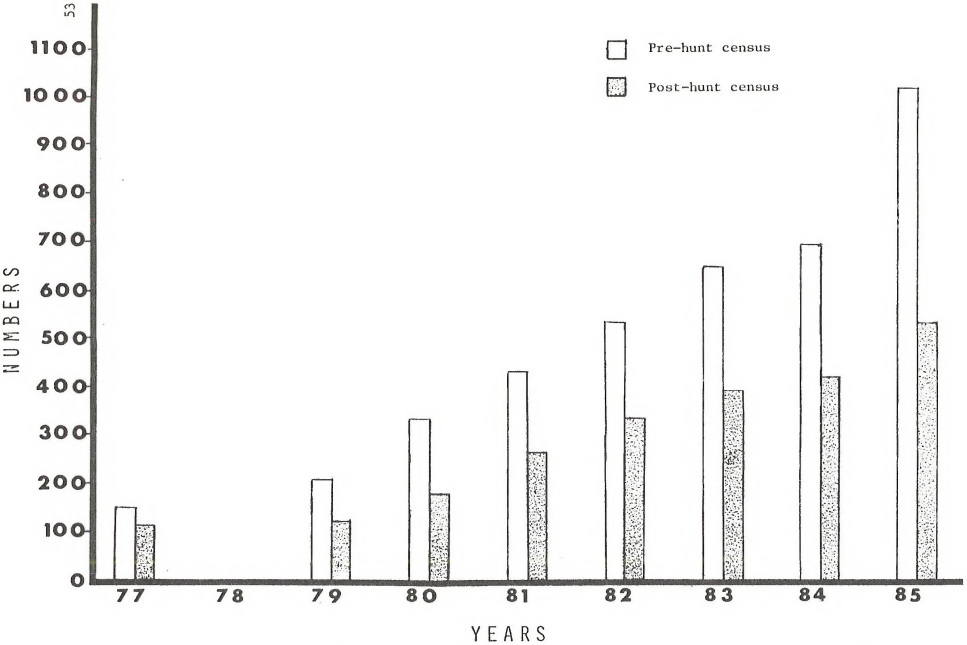


Figure 5. Annual pre- and post-hunt population census of Persian wild goats on the Florida Mountains, 1977 to 1985.

hunt surveys. The population seems to be increasing at a steady rate despite increased hunting pressure. A total of 247 wild goats were removed from the Florida Mountains during the last hunting seasons (Table 15). A similar number (241) were apparentally either lost to crippling, illegally taken, or have moved from the mountain range between the pre- and post-hunt censuses. Over the past 8 years unexplained losses have averaged 26% of the annual population (Table 15 and Figure 6). Many factors could be responsable for such high percentages. The highest known percentage taken legally was 27% and the average legal harvest has been 14% for those 8 years. These numbers do not provide an explanation of population changes in the wild goat herd.

Hunting pressure has not been sufficient to control wild goat numbers at 400 animals, which was the latest carrying capacity determined by BLM and NMDG&F personnel. The numbers of wild goats probably will remain unless high hunting pressure is increased and/or other control measures are taken. One side effect of increased hunting pressure on the wild goat population could be increased animal dispersal from the Florida Mountains. This potential for dispersal could dictate the use of other control methods in order to maintain a specific population size.

Carrying Capacity

Annual carrying capacity of the Florida Mountains for the Persian wild goats has been determined by the Las Cruces, BLM office for

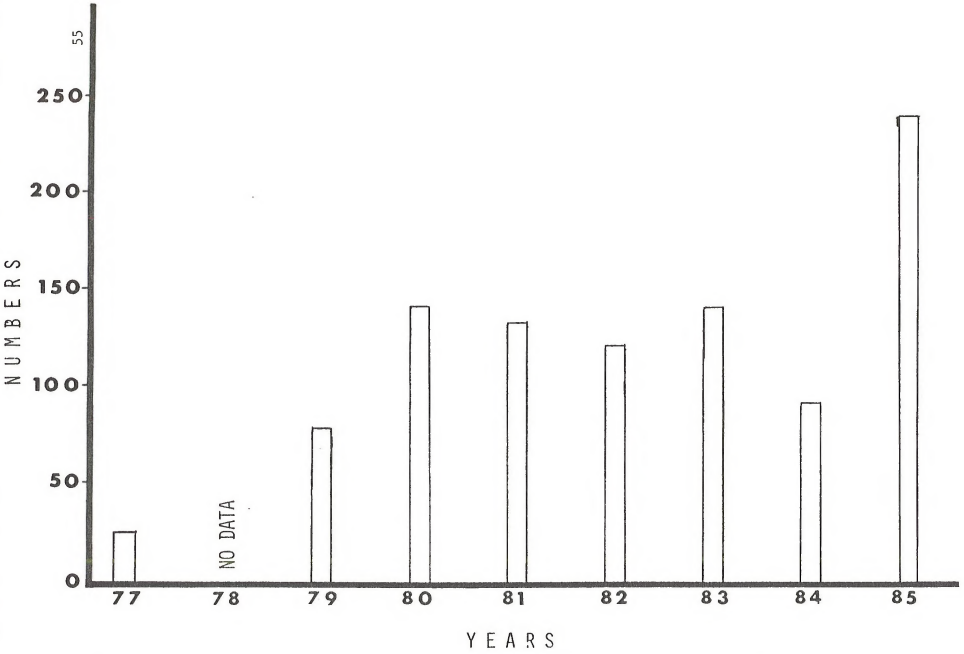


Figure 6. Annual number of Persian wild goats lost to unknown causes on the Florida Mountains, 1977 to 1985.

the past several years (HMP, BLM 1980, 1981, 1982, 1983, 1984 and 1985). To accurattely determine carrying capacity, some estimate of production of key plant species must be obtained. This type of information was not available. In addition, carrying capacity of an area changes frequently during most years. Therefore, it should not be based upon a single annual sample of the vegetation. Samples of both production and utilization of key species are needed to adequately assess changes. The following evaluation of annual carrying capacity determinations, therefore is acheived with limited available information.

The recommended carrying capacity, set in 1979, was 250 wild goats. Since neither the pre-hunt census (208) nor the post-hunt census (118) exceded the limit, this number was acceptable. Only preliminary browse condition data were collected in 1979 while transects were being established.

Data from browse transects in 1980, covering a period of 1979-80, indicated the vegetation on the mountain range was able to maintain the 1979 wild goat numbers. The carrying capacity was set at 250 wild goats. The pre-hunt population of wild goats was 334 and post-hunt population was 178 in 1980. Data from the 1981 browse transects, for the period 1980-81, showed frequency of use of key species and vigor (Figure 3) on the upswing even though rainfall had decreased (Table 13) from the previous year. The bulk of the critical winter browse use can be contributed to the post-hunt population of 178 wild goats. The mountain range was

able to sustain these numbers of wild goats and probably could have sustained pre-hunt numbers of 334. Therefore, the set carrying capacity number of 250 wild goats was acceptable for 1980.

In 1981, the allowable number of wild goats was set at between 178 and 300 animals. During the pre-hunt survey, 432 wild goats were counted (Table 14). Harvest strategies for that year were sufficient to control wild goat numbers to within the set allowable numbers. The estimated post-hunt population was 259 animals. Based on 1980-81 browse condition improvement, the set allowable wild goat numbers were acceptable. During the period 1981-82, frequency of use of key species had increased and vigor had decreased (Figure 3) from previous years and precipitation amounts (Table 13) were above average. Since the estimated 259 wild goats made-up the winter population on the mountain range, they contributed the most to the increased frequency of use and decreased vigor of the key browse species. The numbers of wild goats appeared to be reaching the allowable number of animals the mountain range would support, given the limitations of high use areas.

Based on information from the 1982 browse transects, for the period 1981-82, the allowable number of wild goats was set at 280 for 1982. The pre-hunt survey showed 537 wild goats (Table 14) and post-hunt numbers were estimated to be 322 wild goats (Table 15). The harvest strategy for 1982 did not reduce the population

to the desired level. The information from 1982 browse transects indicated 280 wild goats would probably approach the upper allowable limits for proper utilization of the key browse species. This is apparent when considering the browse condition in 1982 was a result of 259 wild goats being present during the 1981-82 winter.

The estimated 322 wild goats remaining on the mountain range following the 1982 hunting season were responsible for the browse conditions present during the spring of 1983. At this time, frequency of use of key browse species was the highest of any of the 7 years. However, vigor of Wright's silk tassel appeared to improve when compared to data for 1982. Precipitation for 1982-83 had decreased from the previous year and was the second lowest for any of the 7 years (Table 13). Considering that wild goats appeared to make a major shift in their ranges between 1981-82 and 1982-83 (Table 10) and were more uniformly dispersed over the entire mountain range, Wright's silk tassel may have improved its vigor because the wild goats shifted their diets toward mountain mahogany. (Refer to composition of key browse species between elevation zones and change in diet composition between 1979 and 1985.) Therefore, the number of wild goats (322) appeared to be at or near the maximum allowable number which the mountain range could support during a year with below-average precipitation.

The estimated 322 wild goats, post-hunt for 1982, caused browse

conditions to be unfavorable in the spring of 1983. With these data in mind, the allowable number of wild goats was set at 280 for 1983. The pre-hunt survey tallied 647 wild goats (Table 14) while the post-hunt population was estimated at 388 wild goats (Table 15). The number of wild goats, at post-hunt, on the mountain range was approximately 150% of the allowable number. The 1984 browse transects for the period of 1983-84, however, showed decreased average frequency of use (Table 3) but increased average severe hedging (Table 7) from the previous year. Precipitation was above average for that time period (Table 13). Based on this information the set allowable number was probably acceptable. Hunting strategies for 1983 did not reduce the wild goat population to the allowable number.

In 1984, the allowable number of wild goats was increased to 400 animals. Based on data from the 1984 browse transects, for the period of 1983-84, this allowable number was too high. Although average use decreased, severe hedging of the key browse species increased. Wild goat numbers had increased to a post-hunt number of 696 and was estimated at 418 for the post-hunt population. We believe that the allowable number of wild goats should have been 300 to 325 wild goats, considering the past year's browse information. The 1985 browse transects, for the period of 1984-85, showed decreased frequency of use and increased vigor for the key browse species. Even though wild goat numbers continued to increase, improved browse condition may have been the result of 2 years of high precipitation (Table 13) and better distribution of

wild goats over the mountain range. The increased population did not seem to further deterioriate the condition of the key browse species. Again, this was probably due to more moisture and better animal distribution. Harvest strategies were able to control the wild goat population within the set carrying capacity in 1984.

Based on information collected from the 1985 browse transects, which continued to show continuing improvement of key browse species conditions, the allowable number of 400 wild goats was acceptable. Improved key browse condition was probably due to continued high annual precipitation and continued better distribution of wild goats on the mountain range with possible dispersion off the mountain range. In 1985, a count of 1020 wild goats was recorded during the annual pre-hunt aerial census. The post-hunt count was 532. The 1986 browse tranasects, for the period of 1985-86, showed the lowest frequency of use and improved browse vigor, despite increased wild goat numbers. This information supports the set allowable wild goat number (400) which the range could withstand during 1985-86. Hunting strategies were not able to reduce the wild goat numbers to the recommended allowable number.

Considering the above information, it is our opinion that the minimum allowable number of wild goats that the vegetation, or more specifically the 3 key browse species, can withstand on the Florida Mountains is approximately 350 wild goats. However, as

stated earlier, a more accurate determination of final carrying capacity cannot be obtained without some measure of production and utilization of key browse species. The allowable number of 350 wild goats was determined by considering when the vegetation was at the lower limit of browse condition. This takes into account precipitation, vigor, frequency of use, fecal groups per acre, aerial census numbers, possibility of dispersal, and past harvest strategies. Considering the variable precipitation over the study period and the possibility of drought conditions characteristic of the southwest, the allowable number was derived from the point where the key browse species were considered to be showing decreased condition during average or below average precipitation years. Conversely, precipitation can be above average for 2 or more consecutive years, thus greatly enhancing the condition factors of the 3 key browse species. Under these conditions the Florida Mountains probably could support up to 500 wild goats in some years without permanently damaging the browse species.

RECOMMENDATIONS

1. The current method used to determine carrying capacity on the Florida Mountains for Persian wild goats should be changed. Basing the recommended increase or decrease of the wild goat population on the percentage change (increase or decrease) in frequency of use of Wright's silk tassel is invalid. For example, if the frequency of use of Wright's silk tassel (current AUF is 40%) exceeded the AUF by 40 percentage points from 1 year to the next, then the wild goat herd would receive a recommended reduction of 40% from the previous year's allowable number under the current system. Actually this is conservative since the AUF for Wright's silk tassel has been exceeded by 100% and the herd should be reduced by a much greater percentage to be mathematically sound. However, since AUFs are based on frequency of browsing, there is no indication that actual use has increased by 100% because there are no data being gathered regarding production and utilization. A smaller number of long leaders on Wright's silk tassel could receive a higher relative use, but lower actual use, than would a larger number of short leaders. It is common knowledge that environmental factors, which change from year to year, greatly influence the number, length and weight of the leaders produced during a growing season. Even the time and amount of browsing during the year have been documented to effect the following year's growth for most browse species. Therefore, carrying capacity should not

be based on frequency of browsing on 1 or 2 key browse species.

2. Methods of data collection for making carrying capacity determinations on the Florida Mountains for Persian wild goats need to be intensified, particularly for vegetation. A production study should be initiated for the 3 key browse species. Data should be collected in the autumn for several years to establish baseline data and to determine the role varying rates of precipitation have upon plant growth. Similar data collections should be made during the spring to determine amounts of utilization under these environmental variables. These data should be collected along permanent transects so additional statistical models could be employed to test actual changes in production and utilization of each of the 3 key browse species on an annual basis.

   The wild goat population should continue to be counted, both pre- and post-hunt. The pre-hunt census could be taken earlier in the year, possibly August, in order to allow time to issue the proper number of hunter permits to acheive the desired population numbers for the upcoming winter period. A system similar to that employed by the NMDG&F to establish hunt levels for pronghorn herds in various management units around the state might be feasible.

   Hunter check stations with a mandatory check-out would greatly enhance the population data and allow for more

intensive management of the wild goat herd. These data along with reports of crippling loss could help explain the "unknown" losses that are occurring between the pre-hunt, legal harvest and post-hunt censuses.

A method should be devised that could be used during aerial surveys to record the distribution of sightings of wild goats on the Florida Mountains. These data could help understand wild goat distribution on the mountain during periods of stress (below-average precipitation and hunting pressure).

3. AUFs can be a valid system if they are based upon sound data regarding production and utilization. These kinds of data do not exist for the 3 key browse species on the Florida Mountains. Limited data from Arizona and Colorado indicate mountain mahogany (Cercocarpus montanus) can withstand 75% utilization by weight for several years with no permanent damage to individual plants. Higher rates of use are allowable for shorter periods (1 to 2 years). There was no information found in the literature for either Wright's silk tassel or oak.

   AUFs based upon twig counts which indicate frequency of use (number browsed vs. total twigs counted) can be a valid system if all twigs are counted on each plant on a yearly basis. These data must be used with valid measurments of weights of twigs for each browse species. Examination of 10 twigs on each plant is not a valid sample, even though they

were selected randomly, because ungulates do not feed upon all portions of a plant in a random manner. In addition, these animals do not feed upon all plants in any given year and some plants are seldom utilized, although they may be located near to a plant that receives heavy use year after year.

The current AUFs for the 3 key browse species on the Florida Mountains are just "best guesses" and need to be based upon research data that are site-specific. In addition, these AUFs must be based upon weights and not frequencies of browsing.

4. The available fecal diet data indicate the Persian wild goats have shifted their plant use more toward browse species over the past 6 years. However, these data are not complete since there were no samples collected between 1979 and 1985. Therefore, the indicated shift in browse use may be a result of limited data due to the small sample.

   The comparison of Persian wild goats' diets between the north ans south ends of the Florida Mountains indicate no significant difference in the plants being utilized. However, this comparison was based upon 2 samples, 1 for the autumn and 1 for the winter. Since there are no data on availablity of food species, no determinations of preferrence were made. Fecal diet data should continue to be collected annually from both the north and south ends of the

Florida Mountains in order to determine changes in diets that may occur. Samples should be collected early in the growing season to determine if forbs and grasses are more critical during this period. A collection should be made during late summer and mid-winter determining possible seasonal differences in diet selection.

5. The annual carrying capacities for Persian wild goats on the Florida Mountains have been conservative and have not been detrimental to the vegetation. The method used to determine use (frequency of browsing) is inherently an underestimate of actual use. Therefore, the actual use on the 3 key browse species probably exceeded the AUFs only in the 1982-83 winter. This occurred during a period of below-average precipitation and with a wild goat population that was above the recommended number. Keep in mind that the current AUFs probably are conservative and these browse species probably can recover from 1 to 2 years of heavy use, if environmental factors become favorable for them or if the browsing pressure is reduced thereafter. Even in those years when the wild goat population exceeded the allowable number (1983, 1984 and 1985), but average or above precipitation occurred, the frequency of browsing declined. The available browse data give no indications of either a declining plant population or a shift in species composition.

   We recommend a final carrying capacity of 350 to 500 Persian

wild goats on the Florida Mountains following the annual harvest. The lower number should not be permanently detrimental to the vegetation in years of below-average precipitation, and the upper limit number would allow for utilization of increased forage production during periods of above-average precipitation. Following studies to determine actual production and utilization, these numbers probably will need to be adjusted in order to properly manage the vegetation on the Florida Mountains.

LITERATURE CITED

Anonymous. No Date. Big game habitat analysis for New Mexico. Interagency Habitat Analysis Report.

Bavin, R. L. 1975. Ecology and behavior of the Persian ibex in the Florida Mountains, New Mexico. M.S. Thesis. Colorado State Univ., Ft. Collins. 141pp.

Durham, J. L. 1969. Preliminary investigations to the release of exotic ungulates in New Mexico. M.S. Thesis. New Mexico State Univ., Las Cruces. 56pp.

Morrison, B. L. 1983. Harvest strategies to control exotic ungulate populations in New Mexico. Proc. Symp. Game Harvest Manage. Caesar Kleberg Wildl. Research Institute. Kingsville, Texas. 12pp.

Neff, D. F. 1970. Effects of simulated use on the vigor of browse plants, p. 121-174. In Wildl. Research in Ariz., 1969-1970. Arizona Game and Fish Dept., Phoenix.

New MexicoDepartment of Game and Fish. 1984. Persianibex population trends, distribution,and Harvest.Perform. Report. W-93-R-27. Santa Fe, N.M. 5pp. (mimeo.)

Shephard, H.W. 1970. Effects of variable clipping on key browse species in southwestern Colorado. Colo.FAP WP3, J7. Colorado Division of Game, Fish and Parks., Denver.

Sutcliffe, D. 1972. Post-release investigations of Iranian ibex in New Mexico and evaluation of a proposed release site. M.S. Thesis. New Mexico State Univ., Las Cruces. 38 pp.

U.S.Bureau of Land Management. 1979. Habitat Management Plan for the FLorida Mountains. NM-3WAA-T-17. Las Cruces, N.M. 14pp. (mimeo.)

_____. 1980. Florida Mountains, HMP. Annual Report FY 80. Las Cruces, N.M. 4pp. (mimeo.)

_____. 1981. Florida Mountains, HMP. Annual Report FY 81. Las Cruces, N.M. 9pp. (mimeo.)

_____. 1982. Florida Mountains, HMP. Annual Report FY 82. Las Cruces, N.M. 10pp. (mimeo.)

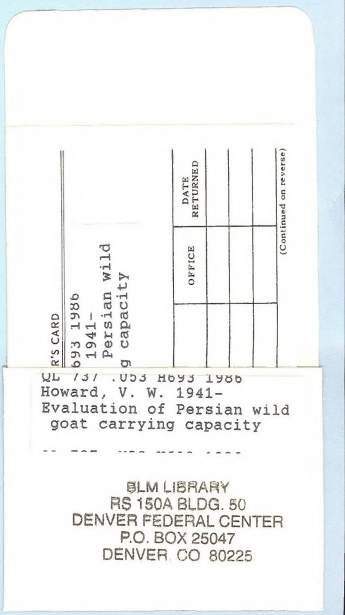
_____. 1983. Florida Mountains, HMP. Annual Report Fy 83. Las Cruces, N.M. 5pp. (mimeo.)

_____. 1984. Florida Mountains, HMP. Annual Report FY 84. Las Cruces, N.M. 6pp. (mimeo.)

_____. 1985. Florida Mountains, HMP. Annual Report FY 85. Las Cruces, N.M. 6pp. (mimeo.)

U.S. Department of Commerce Environmental Science Services Administration Weather Bureau. 1967. Normal Annual Precipitation. State of New Mexico. 1931-1960. Interior Geological Survey, Wash. D.C. 1967.

Woodroof, W. O. 1979. Ecology and behavior of the Persian wild goat (Capra aegagrus) in New Mexico. M.S. Thesis. New Mexico State Univ., Las Cruses. 95pp.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